

## **Notice of Interest**

### **DE-AR52-10NA29853**

February 25, 2010

This Notice of Interest concerning the release of a Broad Agency Announcement (BAA) to solicit research and development (R&D) regarding Nuclear Explosion Monitoring Research and Development (NEM R&D) is issued in accordance with 10 CFR Part 600 and 48 CFR Part 35.016. Offerors should not submit a proposal in response to this Notice of Interest, but may submit a proposal after release of the solicitation.

**Description:** The United States Air Force Research Laboratory (AFRL), the Department of Energy's National Nuclear Security Administration (NNSA), and the Department of State (DOS) will jointly solicit proposals for R&D to improve capabilities to detect, locate, and identify nuclear explosions. It is anticipated that this planned solicitation will be released on or about March 30, 2010 and close on or about May 18, 2010 seeking proposals with a period of performance of 1-3 years with awards starting in fiscal year (FY) 2011. Research products developed under this planned solicitation shall support Air Force requirements for improving the nuclear explosion monitoring capabilities and other U.S. verification needs.

The objective of this planned solicitation is to enhance U.S. capabilities in nuclear explosion monitoring primarily with ground-based systems. Proposals that enhance U.S. capabilities that also benefit the international monitoring capabilities in the context of preparations for a Comprehensive Nuclear Test Ban Treaty may be submitted. This will be achieved through advances in the state-of-the-art for nuclear explosion monitoring, basic and applied research that enhances understanding of the underlying phenomena, developing new methods of tackling monitoring problems, or gathering new data for use in nuclear explosion monitoring.

Individual proposals should be directed to only one of the topic sub-areas described below, but the Offeror may submit proposals in more than one topic sub-area. All topic sub-areas are of importance. However, depending on the proposals received and programmatic needs, funding may not be distributed evenly among the topic sub-areas.

Research is being sought in the following topic areas:

#### **TOPIC 1: Source Physics**

#### **TOPIC 2: Signal Propagation**

#### **TOPIC 3: Sensors**

#### **TOPIC 4: Signal Processing**

#### **Topic 1: Source Physics**

**1a. Advanced Explosion Models.** Proposals are sought that complement existing efforts and/or propose new ideas to further understand of seismic energy generation from a range of sources (explosions, earthquakes, mine collapses, and other modes of rock failure), and how seismic energy is partitioned between P, S, and surface waves. Advanced explosions models are

sought that include this new understanding as well as coupling of source models with propagation models. New methods of estimating the yield of fully and partially -coupled explosions, and how emplacement conditions influence the observations, are of interest. Proposals for theoretical and observational investigations will be accepted under this topic.

If your research would benefit from a field experiment, please list any specific needs to be adhered to in order to get scientifically valid results (e.g., size/magnitude of explosion, depth of explosion, type of rock, and emplacement conditions, relationship to water table, relationship to known faults, initial subsurface stress). Field experiments may be proposed at the Nevada Test Site or other locations. Please demonstrate/document in the proposal a genuine partnership to ensure the feasibility of the experiment as well as data sharing. This is particularly important if the field experiment is outside the United States.

**1b. Local and Regional Monitoring.** Proposals are sought that would produce new understanding of the properties of small seismic events and their seismic waveforms at local (200 km or less) and regional (2,000 km or less) distances. Innovative methods of event detection that are appropriate for local events are of interest. Of particular interest are methods for estimating yield of seismic events recorded at local and near-regional distances with low uncertainty, including methods that are region-specific and allow validation. These methods could for example use Pn, Pg, Sn, Lg and coda. New methods for discriminating explosions from earthquakes that have a firm physical and statistical basis are of interest. Methods that can discriminate chemical from nuclear explosions are also of interest.

**1c. Xenon Sources and Background.** Proposals are sought for the study of source terms for Xe producing natural, medical, industrial, military and nuclear processes, the fate and transport of the Xe released and the regional backgrounds that might be encountered. Studies and models of Xe and other fission product leakage from historical underground weapons tests are also sought.

**1d. Infrasound Studies: Seismo-Acoustics.** Proposals are sought on the interpretation of signals from co-located infrasound and seismic sensors at local and regional distances. Improved understanding of the fundamental physics of generation of infrasound from underground and near-surface explosions and other sources is desired. The maximum infrasound signal expected from events that do not have a surface component of energy release, such as shallow earthquakes, and the nature of such a signal (impulsive or emergent) are of interest. Experimental, observational and theoretical studies are of interest.

**1e. Hydroacoustic Studies: Phenomenology.** Proposals that quantify the types and variance of events and background noise at new stations are of interest. Proposals that mine existing data for reference explosive events and ground truth for discrimination are sought. Coupling from sources in shallow water and at the air-water interface is of particular interest.

## **Topic 2: Signal Propagation**

**2a. Velocity Models.** Proposals are sought that develop advanced models of the Earth's velocity structure with predictive capability, especially in aseismic regions and in Eurasia. Of particular interest are: new techniques of determining 3-D, spatially variable velocity models; techniques for building models by fitting multiple datasets, especially of different types of data; techniques to estimate the uncertainty in geophysical models and assess the tradeoffs between different parameters of the models, as well as the uncertainty in predicted observables, such as travel times; studies that compare different methods to show their strengths and weaknesses; and models that can predict seismic amplitudes as well as travel times. Priority will be given to



studies of Eurasia. The influence of laterally-varying 2-D, 2.5-D, and 3-D structures, including 3-D scattering, on the stability of propagation of Pn, Pg, Sn, and Lg phases and how these phases propagate to local (less than 200 km) and regional distances (less than 2,000 km) are of interest.

**2b. Attenuation Models.** Proposals are sought to develop local and regional attenuation models, with emphasis on their ability to match observed amplitudes of Pn, Pg, Sn, and Lg phases, their codas, and surface waves. Proposals to develop new methods for measuring attenuation, to estimate uncertainty in attenuation models, and to develop models that fit multiple datasets (e.g. body wave and surface wave amplitudes), are of interest.

**2c. Location and Discrimination Ground Truth.** Proposal are sought for seismic location calibration, collection of ground truth at a GT5 level (absolute location and depth errors less than 5 kilometers) or better, including dedicated explosions for events of magnitude 2.5 and larger. Research on new methods of acquiring location ground truth will be accepted under this topic. Studies that generate new discrimination ground truth events, along with source geometry and other characterizing information, are sought. Calibration of regional coda magnitude is of interest. Improved techniques for event location using models and/or ground truth at local, regional or near-teleseismic distances, particularly methods that use more than a single type of data jointly are of interest. Robust estimation of uncertainty is an important consideration.

**2d. Infrasound Studies: Propagation.** Propagation of infrasound signals to local and near-regional distances (less than 1,000 km) is of interest, particularly the phenomenology governing reception and characteristics of infrasound signals within the so-called zone of silence. Atmospheric conditions that affect detection, phase association, yield estimation, and event identification are of particular interest. Another topic of interest is the uncertainty in azimuth and range determinations for infrasound signals from seismic events at local and regional distances.

### Topic 3: Sensors

**3a. Xenon Measuring Instrument.** Proposals are sought for the development of compact instrumentation for the quantification of stable xenon as part of a radioactive xenon monitoring instrument with the objective of determining the total amount of stable xenon in a mixed gaseous sample (xenon in nitrogen) from independent measures of pressure, temperature and mole fraction of xenon in order to calculate the stable volume (standard cc's). This measurement is challenging due to the low pressures (1-100 torr) expected during the quantification, placing constraints on the binary gas analysis technique therefore it is expected that new gas sensing technologies will be developed under this project.

The combined relative uncertainty (random and systematic) in the reported volume should be less than 1%. The technology should be robust, field deployable and not require regular calibration (6 months between calibration checks). The anticipated quantity of xenon available for the measurement is  $0.25 \text{ cm}^3$  (standard temperature and pressure). The amount of nitrogen is anticipated to be in the range of  $0.25 - 0.75 \text{ cm}^3$  (STP). A desired outcome from this work would be a compact instrument or technique usable for both laboratory and automated and unattended field measurements.

### Topic 4: Signal Processing

**4a. Signal Processing.** We seek new and innovative signal processing methods for data from local (less than 200 km) and regional (less than 2,000 km) distances that significantly lower the thresholds at which detection, location and identification functions can be performed at an acceptable false alarm rate. Methods that make use of more of the seismic waveforms than



simply arrival times and amplitudes are sought. Methods that make use of full seismic waveforms, including waveform matching, are of particular interest. Studies should assess success and failure rates and the effect of less than perfect waveform matching. Estimating improvements in detection, including testing of detection processes using superposition of actual signals in increasing noise, is of interest. Tuning studies, either of specific arrays or of techniques in general, are not sought.

**4b. Synthetic Seismograms.** Innovative methods of computing synthetic seismograms in reasonable frequency bands for local, regional, and near teleseismic distances are of interest. Some topics of particular interest are 3-D computations in large models, efficient methods for 2.5-D calculations, hybrid or approximate methods that have significant advantages over other methods, and methods that calculate realistic spectra or envelopes. New methods that couple near-source conditions to far-field observations are also of interest.

\*\*\*\*\*END OF TOPICS\*\*\*\*\*

The BAA will solicit proposals from all responsible organizations (foreign and domestic) including industry, academic institutions, research institutions, and non-profit organizations.

The United States Air Force Research Laboratory (AFRL), the Department of Energy's National Nuclear Security Administration (NNSA), and the Department of State (DOS) are strong advocates for the small business community and interested small businesses, small business-lead teams, and joint ventures that qualify as small businesses, are especially encouraged to submit proposals under this BAA.

Federal agencies may submit proposals as prime/lead contractors subject to appropriations language but may not partner with Federally Funded Research and Development Centers (FFRDC). FFRDCs, including NNSA national laboratories, cannot directly respond to this solicitation as prime/lead participants. FFRDCs, including NNSA national laboratories, may participate in this solicitation as team members; however, such participation must be consistent with the FFRDCs sponsoring agreement. The FFRDC effort for any proposal, in aggregate, shall not exceed 50% of the total effort of the project. Information will be provided in the solicitation on how to include FFRDCs, such as NNSA national laboratories, as a team member(s).

Enhancing programmatic value is encouraged. Low-cost proposals focused on validation or proof-of-principle issues will enhance programmatic value. Teaming is, also, an interesting way to add value, for example, teaming to facilitate integration of research products into the Knowledge Base will enhance programmatic value. Teaming which results in the training of graduate students (in particular university/industry teams working on real world problems with Ph.D. candidates) will enhance programmatic value. Programmatic value is anticipated to be one of the selection criteria for proposals. If teaming arrangements are proposed, a clear statement of the intended benefit of teaming must be provided along with the proposed technical approach, deliverables and costs clearly delineated for individual team members. The Government reserves the right to award to the team or to individual team members.

AFRL, NNSA, and DOS will require a final report of each award and will distribute the final report to each sponsoring agency party to this solicitation, and will actively facilitate a successful

transition to national monitoring and verification operations. Awards are eligible to have an NNSA Product Integrator (subject matter expert) assigned at the time of award to help ensure the successful transitioning of research products to operations. Information about the NNSA Nuclear Explosion Monitoring Research and Development (NEM R&D) program integration of research products into operational form for the Air Force can be found online at <https://na22.nnsa.doe.gov/KnowledgeBase>.

The funding organization reserves the right to determine which funding instrument shall be used. The funding instrument shall be appropriate to the scope of work and performing organization. NNSA will predominantly issue contracts, but financial assistance awards may be used under certain circumstances. The Department of Defense and the Department of State will choose the appropriate funding vehicle for the award. In the event a contract is issued, acquisition regulations apply per 48 CFR, and a cost reimbursement type contract is anticipated. In the event a financial assistance instrument is issued, 10 CFR 600 applies, a cooperative agreement is anticipated.

The NNSA, AFRL, and DOS each reserve the right to fund, in whole or in part, any, all or none of the proposals and to award without discussions between the funding organization and the awardee. Other Federal funding organizations may join this BAA action and award funding instruments based on proposals submitted in response to this BAA action. This Notice of Interest is being issued in advance of passage of FY 2011 appropriations to provide more time for potential offerors to prepare and to allow awards to be made as early as practicable within FY 2011. The final number of topics and awards, however, are subject to the availability of funds.